FLORIDA DEPARTMENT OF TRANSPORTATION
State Materials Office
5007 NE 39th Avenue
Gainesville, Florida 32609

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Florida Test Method for Evaluation of Pavement Markings Materials with Friction Requirements

Designation: FM 5-622

Part A – Laboratory Evaluation

1. Scope

This method covers the laboratory testing procedures for evaluation of pavement marking materials requiring friction. The pavement marking materials under this test method include green colored pavement marking materials (GCPMM), preformed thermoplastic (FDOT Section 711), and patterned pavement. In addition to friction resistance, color and retroreflective properties (if applicable) will be evaluated using laboratory testing panels.

2. Apparatus

2.1 Three Wheel Polishing Device (TWPD).

2.2 Dynamic Friction Tester (DFT) - This apparatus is standardized in accordance with **ASTM E1911**, "Standard Test Method for Measuring Paved Surface Frictional Properties Using the Dynamic Friction Tester."

2.3 Accelerated Weathering Chamber - This apparatus is standardized in accordance with **ASTM D7869**, "Standard Practice for Xenon Arc Exposure Test with Enhanced Light and Water Exposure for Transportation Coatings."

2.4 Spectrophotometer- This apparatus is standardized in accordance with **ASTM E1349**, "Standard Test Method for Reflectance Factor and Color by Spectrophotometry Using Bidirectional (45º:0º or 0º:45º) Geometry".

2.5 Handheld Retroreflectometer - This apparatus is standardized in accordance with **ASTM E1710**, "Standard Test Method for Measurement of Retroreflective Pavement Marking Materials with CEN-Prescribed Geometry Using a Portable Retroreflectometer."

2.6 Micrometer or caliper shall be used for preformed thermoplastic (FDOT Section 711 and GCPMM) thickness measurement.

2.7 Testing Panel - Vendor shall provide two friction panels for evaluation. Marking material shall be affixed to a rigid, non-compressible, and water-resistant

substrate at least 1/16” thick and no greater than two inches thick, once constructed. Each panel shall have dimensions of 19 ¾” x 15 ¾”. The panel must be uniform and planar. To ensure a proper fit on the testing jig, it is very important that the panels are manufactured to the correct dimensions. The second panel will be kept for a control and referee testing.

For all preformed thermoplastic materials, vendors shall also provide a sample, that is not affixed to panel and is at least 8” x 8”.

For GCPMM, vendors shall provide three additional panels for accelerated weathering. The substrate should be rigid, non-compressible, and water-resistant. The panel dimensions should be 4” x 8” and between 1/16” to 1/4” thick.

3. Test Procedure

This procedure applies to the tests being performed on the entire pavement marking material system, which includes the binder, glass spheres (if applicable), and the anti-skid aggregates. Polishing procedures are performed in a laboratory environment using a TWPD as shown in **Figure 1**. Weathering for GCPMMs is achieved with an accelerated weathering chamber as shown in **Figure 2**. Inspect the panel thoroughly before testing and look for hairline cracks or large voids that might open during polishing and weathering. If there are any signs of tracking on the panel from the polish wheels or distress from weathering, it should be noted on the test report.

3.1 Polishing Procedure

The TWPD should rotate in the counterclockwise direction, polishing the sample at a fixed rate of 60 rpm. The load applied is 100 lbs, with pressure of pneumatic tires maintained at 50 psi, and continuous water wetting on the panels during testing. The stiffness of the tires measured using a durometer should have a shore hardness of 65±5.

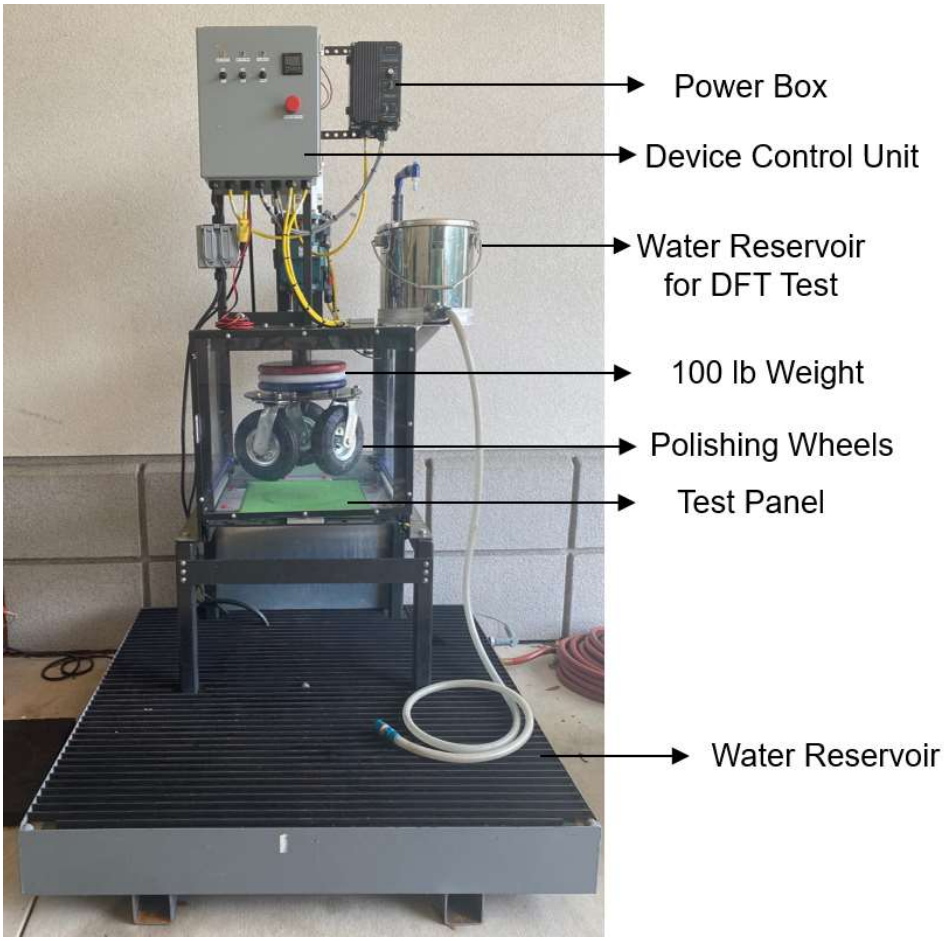

Figure 1. Three Wheel Polishing Device (TWPD) at FDOT-SMO.

3.2 Accelerated Laboratory Weathering Procedure

Set the chamber settings to the parameters in Table 1. Color testing will be performed on two GCPMM panels before and after 250 exposure-hours. The third panel will be kept for a control and referee testing.

Table 1. Weathering Exposure Parameters.

Parameter	Value
Irradiance set at 340 nm	0.51 w/ (m^2. nm)
Light/dark	Continuous Light
Uninsulated Black Panel Temperature Set Point	63°C
Water Spray Cycle	102 minutes no spray 18 minutes water spray
Relative Humidity	50% during light only
Total exposure hours	250

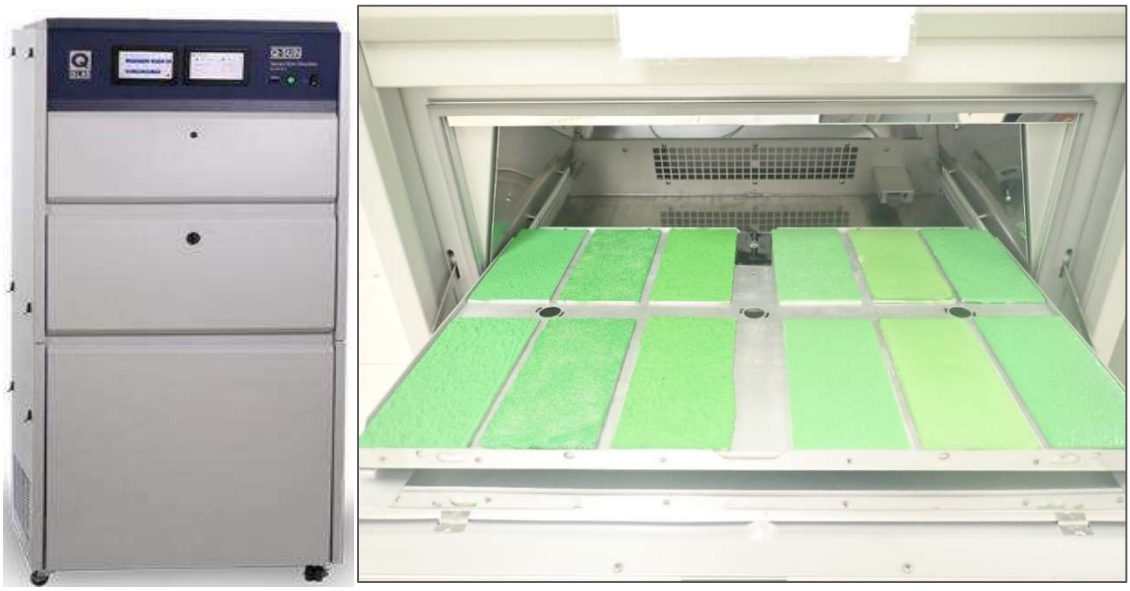

Figure 2. Accelerated Weathering Chamber at FDOT-SMO.

3.3 Friction Test

The friction test shall be conducted on the panels provided from the manufacturer in accordance with **ASTM E1911**. The friction testing should be performed along the same circular path as that of polishing test. Three friction tests will be conducted at each polishing interval. The friction testing will be performed on the panels at intervals of 0, 50,000, 100,000 and 150,000 cycles on the TWPD.

3.4 Color Property Test

The color properties shall be tested in accordance with **ASTM E1349**. Read x, y, and Y data with 45/0 geometry, observer angle of 2º, and illuminant D65.

3.4.1 For GCPMM friction panels, daytime chromaticity coordinates (x, y) and daytime luminance factor (Y) shall be collected at any three (3) random locations on the circular path traversed by the TWPD at each polishing interval. The average of the three (3) measurements shall be used for acceptance of the material.

3.4.2 For GCPMM weathering panels, daytime chromaticity coordinates (x, y) and daytime luminance factor (Y) shall be collected at any three (3) random locations, on each of the two panels, before and after exposure. A total of six (6) measurements shall be taken. The average of the six measurements shall be used for acceptance of the material. The color testing will be performed on the panels at intervals of 0, 50,000, 100,000 and 150,000 cycles on the TWPD.

3.4.3 For preformed thermoplastic (FDOT Section 711) pavement marking material panels, collect initial daytime chromaticity coordinates (x, y) and daytime luminance factor (Y). Measurements shall be collected at any three (3) random locations. The average of the three (3) measurements shall be used for acceptance of the material.

3.5 Retroreflectivity Test

For preformed thermoplastic (FDOT Section 711) pavement marking panels, initial retroreflectivity values should be collected at any three (3) random locations on the panel prior to polish testing in accordance with **ASTM E1710**. The average of the three (3) measurements shall be used for acceptance of the material. This will not apply to GCPMM or patterned pavement.

3.6 Thickness Test

For preformed thermoplastic (FDOT Section 711 and GCPMM) materials, thickness shall be collected on the sample that is not affixed to the panel. A total of six (6) measurements shall be taken using a micrometer or caliper. The average of the six (6) measurements shall be used for acceptance of the material. Record thickness in Material Acceptance Certification (MAC) System.

4. Report

4.1 Preformed Thermoplastic (FDOT Section 711)

Friction numbers for the preformed thermoplastic (FDOT Section 711) panels shall be averaged and reported at each interval using FDOT's Preformed Thermoplastic (FDOT Section 711) - Friction, Color, and Retroreflectivity Report (**Figure 3**). Initial readings for color and retroreflectivity shall be averaged and reported using FDOT's Preformed Thermoplastic Pavement Marking Materials - Friction, Color, and Retroreflectivity Report (**Figure 3**).

4.2 GCPMM

Friction numbers and color properties for the GCPMM panels at each polishing and weathering interval shall be averaged and reported using FDOT's Green Colored Pavement Marking Materials - Friction and Color Report (**Figure 4**).

4.3 Patterned Pavement

Friction numbers for the patterned pavement panels at each interval shall be averaged and reported using FDOT's Patterned Pavement - Friction Report (**Figure 5**).

Preformed Thermoplastic Friction, Color, Retroreflectivity Report

1.	PRODUCT TYPE	
2.	PRODUCT MANUFACTURER	
3.	PRODUCT NAME	
4.	PATH ID NUMBER	
5.	DATE PRODUCT RECEIVED	
6.	DATE TESTED	
7.	ANALYSIS CONDUCTED BY	
Notes:		

TABLE A-1

FRICTION NUMBER (DFT40)				
Test Count	0 Cycles	50,000 Cycles	100,000 Cycles	150,000 Cycles
1				
2				
3				
Average				

TABLE A-2

Test Count	INITIAL CHROMATICITY COORDINATES		INITIAL LUMINANCE FACTOR (Y)	INITIAL RETROREFLECTIVITY (mcd/m2/lux)
	x	y		
1				
2				
3				
Average				

Figure 3. Preformed Thermoplastic - Friction, Color, and Retroreflectivity Report.

Green Colored Pavement Marking Materials - Friction and Color Report

1.	PRODUCT TYPE	
2.	PRODUCT MANUFACTURER	
3.	PRODUCT NAME	
4.	PATH ID NUMBER	
5.	DATE PRODUCT RECEIVED	
6.	DATE TESTED	
7.	ANALYSIS CONDUCTED BY	
Notes:		

FRICTION NUMBER (DFT40)

Test Count	0 Cycles	50,000 Cycles	100,000 Cycles	150,000 Cycles
1				
2				
3				
Average				

LUMINANCE FACTOR (Y)

Test Count	0 Cycles	50,000 Cycles	100,000 Cycles	150,000 Cycles
1				
2				
3				
Average				

CHROMATICITY COORDINATES

Test Count	0 Cycles		50,000 Cycles		100,000 Cycles		150,000 Cycles	
	x	y	x	y	x	y	x	y
1								
2								
3								
Average								

Figure 4. Green Colored Pavement Marking Materials - Friction and Color Report.

Patterned Pavement - Friction Report

1.	PRODUCT TYPE	
2.	PRODUCT MANUFACTURER	
3.	PRODUCT NAME	
4.	PATH ID NUMBER	
5.	DATE PRODUCT RECEIVED	
6.	DATE TESTED	
7.	ANALYSIS CONDUCTED BY	
Notes:		

TABLE A-1

FRICTION NUMBER (DFT40)				
Test Count	0 Cycles	50,000 Cycles	100,000 Cycles	150,000 Cycles
1				
2				
3				
Average				

Figure 5. Patterned Pavement - Friction Report.

Part B – In-Service Evaluation

1. Scope

This method covers the testing procedures for in-service evaluation of friction resistance, retroreflectivity, wear, and pavement distresses.

2. Apparatus

2.1 Dynamic Friction Tester (DFT) - This apparatus is standardized in accordance with **ASTM E1911**, "Standard Test Method for Measuring Surface Frictional Properties Using the Dynamic Friction Tester".

2.2 Locked Wheel Friction Tester- This apparatus shall be standardized in accordance with **ASTM E274**, "Standard Test Method for Skid Resistance of Paved Surfaces Using a Full-Scale Tire". The friction test tire used shall be in accordance with **ASTM E501**, "Standard Specification for Standard Rib Tire for Pavement Skid-Resistance Tests".

2.3 Handheld Retroreflectometer - This apparatus is standardized in accordance with **ASTM E1710**, "Standard Test Method for Measurement of Retroreflective Pavement Marking Materials with CEN-Prescribed Geometry Using a Portable Retroreflectometer".

3. Test Procedure

3.1 Preformed Thermoplastic (FDOT Section 711)

3.1.1 Friction tests shall be performed in areas representative of the entire pavement marking section. A total of three DFT tests shall be conducted on each pavement marking; one test for each test location, as shown in **Figure 6**.

3.1.2 Retroreflectivity measurements shall be taken in areas representative of the entire pavement marking section. Three replicated runs are required on each test location as shown in **Figure 6**.

3.2 GCPMM

3.2.1 All friction testing should be performed with a DFT on the 2' to 4' dotted line portion of the GCPMM located within the keyhole lane areas of the green-colored bike lane sections as shown in **Figure 7**. In the absence of a keyhole lane, the tests can be performed as per the guidance provided in **Figure 7**.

3.2.2 Friction test shall be conducted at three (3) different discrete 2'-4' dotted lines in keyhole lane per project as shown in **Figure 7**.

3.2.3 Wear Evaluation - the wear rate of the GCPMM is computed using the affected area divided by the total area, expressed as a percentage.

3.2.4 Pavement distress of the GCPMM shall be documented with visual estimation of affected area and dominant distress types.

3.3 Patterned Pavement

The Lock Wheel Friction Tester or the DFT may be used to evaluate patterned pavement.

3.3.1 Friction Test - Lock Wheel Friction Tester

The locked wheel test will require three repeat lockups and averaged for the designated test lane. The lane in which the friction tests were conducted must be identified in the report along with the test results. The test layout is shown in **Figure 8**.

3.3.2 Friction Test - DFT

DFT tests shall be conducted at three (3) discrete locations; the results shall be averaged and reported for the designated test lane. The lane in which the friction tests were conducted must be identified in the report along with the test results. The test layout is shown in **Figure 8**.

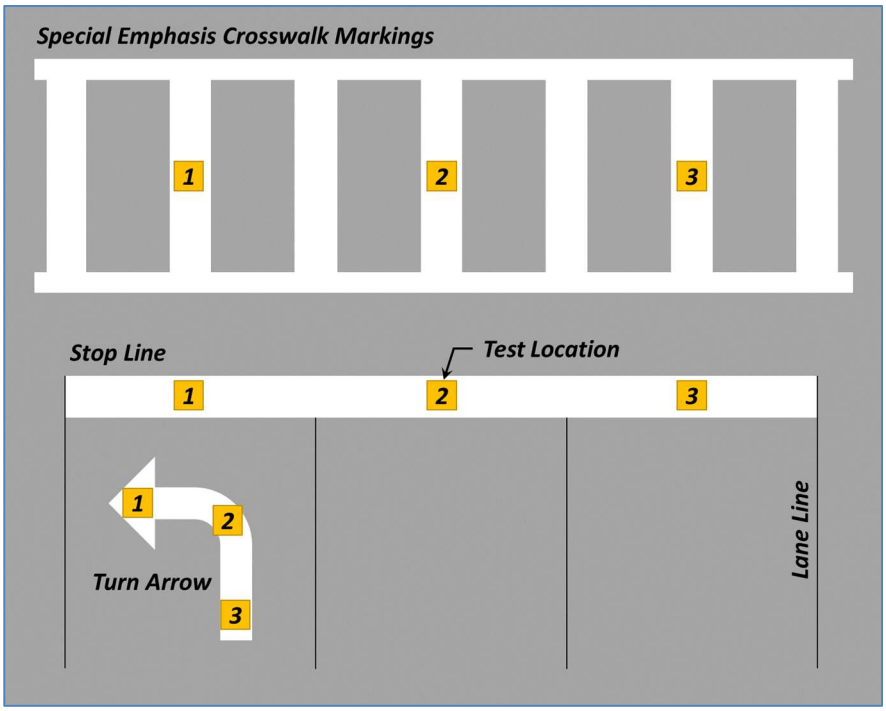

Figure 6. Testing Protocol for Preformed Thermoplastic Sections.

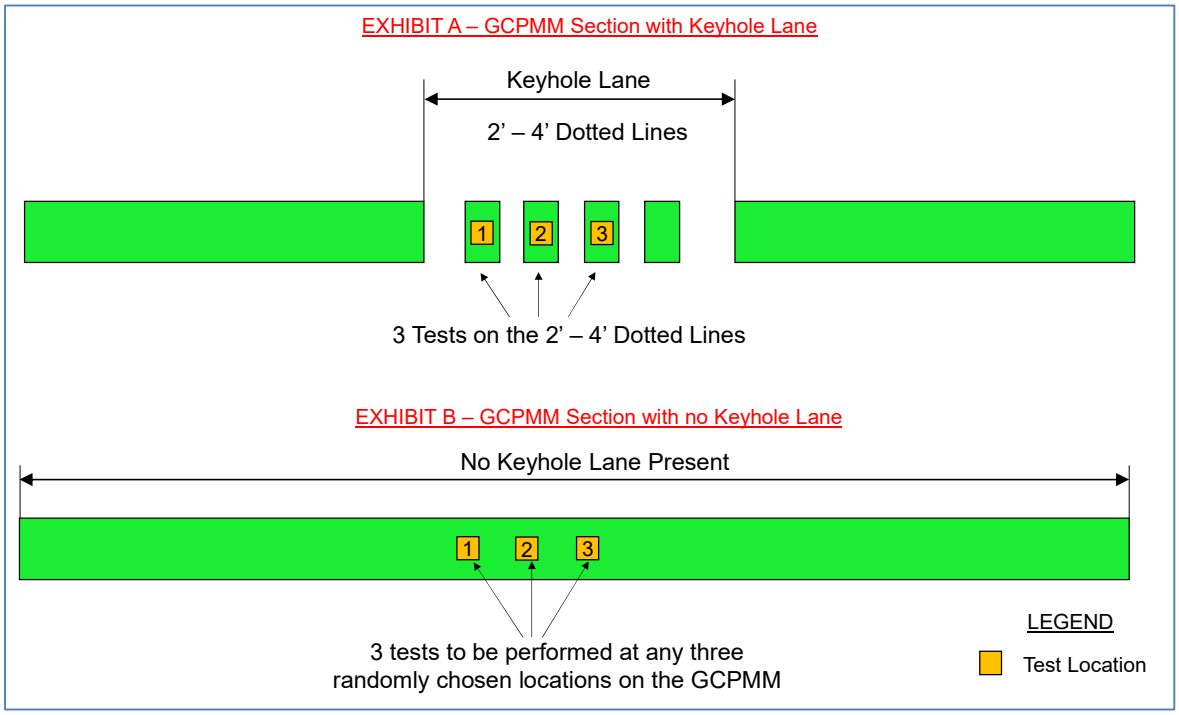

Figure 7. Testing Protocol for Green-Colored Pavement Marking Materials Sections.

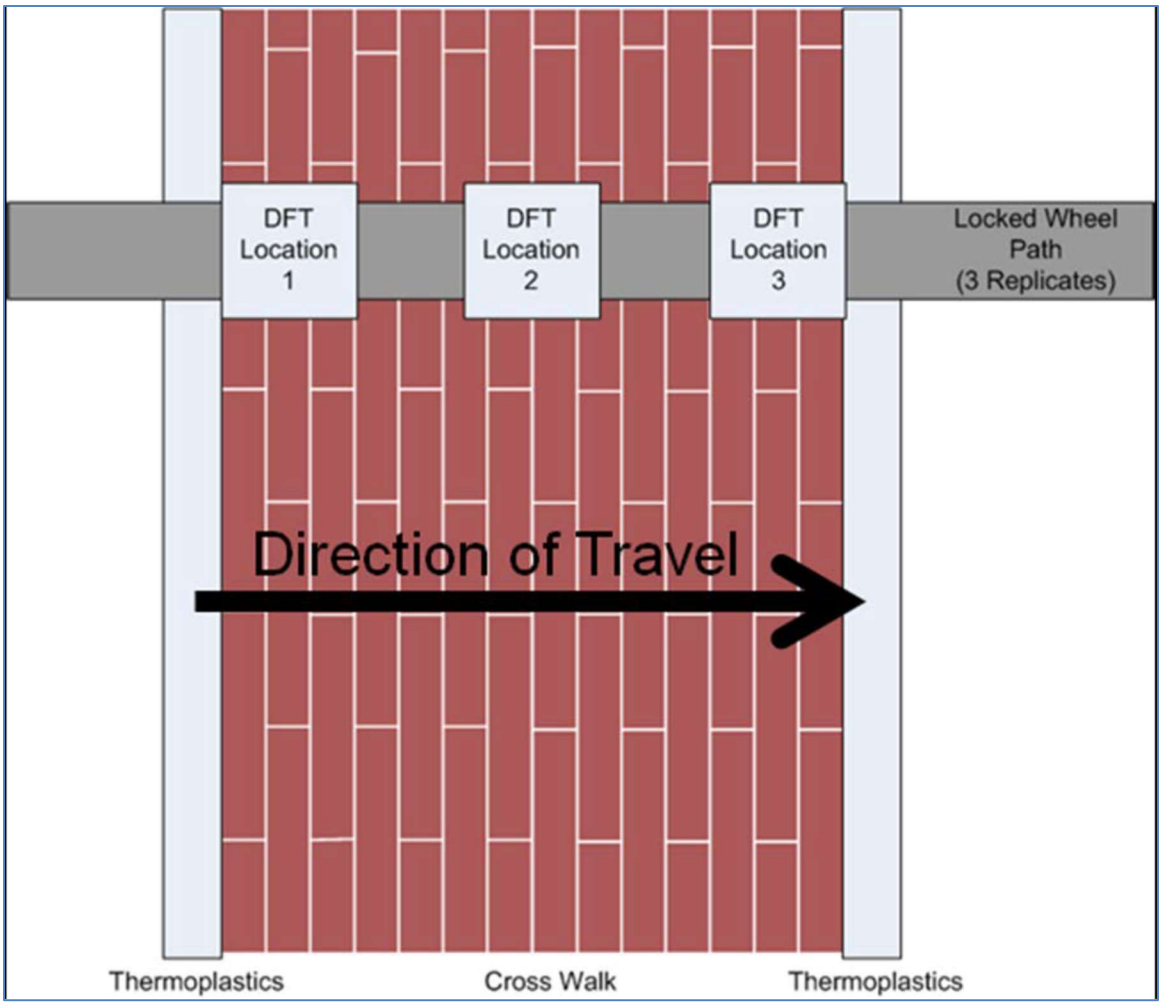

Figure 8. Testing Protocol for Patterned Pavement Sections.

4. Report

4.1 Friction numbers and retroreflectivity for the preformed thermoplastic shall be averaged and reported using FDOT's Preformed Thermoplastic - Friction and Retroreflectivity Report (**Figure 9**).

4.2 Friction numbers, wear, and pavement distress properties for the GCPMM shall be averaged and reported using FDOT's Green Colored Pavement Marking Materials - Friction, Wear, and Pavement Distress Report (**Figure 10**).

4.3 Friction numbers for patterned pavement shall be averaged and reported using FDOT's Patterned Pavement - Friction Report (**Figure 11**).

Preformed Thermoplastic Friction and Retroreflectivity Report

1.	DISTRICT	
2.	COUNTY NAME	
3.	FINANCIAL PROJECT NUMBER	
4.	COUNTY SECTION NUMBER	
5.	STATE ROAD, U.S., AND INTERSTATE NUMBER	
6.	MILEPOST OF TESTING LOCATION	
7.	SPEED LIMIT	
8.	AVERAGE DAILY TRAFFIC (2 WAY)	
9.	PRODUCT TYPE	
10.	PRODUCT MANUFACTURER	
11.	DATE PRODUCT INSTALLED	
12.	DATE TESTED	
13.	ANALYSIS CONDUCTED BY	
14.	TEST TYPE	
15.	COMMENTS:	

Location	DFT40	Average DFT40	COMMENTS
1			
2			
3			

Location	RL VALUE		Average RL	COMMENTS
1	1			
	2			
	3			
2	1			
	2			
	3			
3	1			
	2			
	3			

Figure 9. Preformed Thermoplastic - Friction and Retroreflectivity Report.

Green-Colored Pavement Marking Materials Friction, Wear and Pavement Distress Report

1.	DISTRICT	
2.	COUNTY NAME	
3.	FINANCIAL PROJECT NUMBER	
4.	COUNTY SECTION NUMBER	
5.	STATE ROAD, U.S., AND INTERSTATE NUMBER	
6.	MILEPOST OF TESTING LOCATION	
7.	SPEED LIMIT	
8.	AVERAGE DAILY TRAFFIC (2 WAY)	
9.	PRODUCT TYPE	
10.	PRODUCT MANUFACTURER	
11.	DATE PRODUCT INSTALLED	
12.	DATE TESTED	
13.	ANALYSIS CONDUCTED BY	
14.	TEST TYPE	
15.	COMMENTS:	

FRICTION TESTING

RUN	DFT40	DIRECTION	COMMENTS
1			
2			
3			
Average DFT 40			

WEAR PERCENTAGE

DIRECTION	PERCENTAGE	COMMENTS

PAVEMENT DISTRESSES

DISTRESS? YES/NO	DIRECTION	DESCRIBE DISTRESS

Figure 10. Green Colored Pavement Marking Materials - Friction, Wear, and Pavement Distress Report.

Patterned Pavement Friction Report

1.	DISTRICT	
2.	COUNTY NAME	
3.	FINANCIAL PROJECT NUMBER	
4.	COUNTY SECTION NUMBER	
5.	STATE ROAD, U.S., AND INTERSTATE NUMBER	
6.	MILEPOST OF TESTING LOCATION	
7.	SPEED LIMIT	
8.	AVERAGE DAILY TRAFFIC (2 WAY)	
9.	PRODUCT TYPE	
10.	PRODUCT MANUFACTURER	
11.	DATE PRODUCT INSTALLED	
12.	DATE TESTED	
13.	ANALYSIS CONDUCTED BY	
14.	TEST TYPE	
15.	COMMENTS:	

RUN	DFT40	COMMENTS
1		
2		
3		
Average DFT40		

Figure 11. Patterned Pavement - Friction Report.